

Killer Whale Recovery

High School: Natural History and Population Parameters

Lesson 1: Trading Cards

	Subject Area(s): Killer whale natural history, classification, social structures, population parameters, analyze graphs and compare two similar population sizes.	Duration: one 50 minute period
	Key words: ecotypes, matriline, pods, clans, community, birth and death rates, predation, prey requirements, habitat destruction, competition for resources, biological impacts vs. human impacts, carrying capacity, and population bottleneck (genetics)	
Materials:	Killer Whale Trading Cards or I.D. catalogue, plastic bottle with hole at bottom, worksheet, computers with internet access	
State Standards: WA, OR, and ID	WA: EALR 2, 9-12 INQH (citations for all ideas from research work) EALR 4, 9-12 LS3E (classification using similar and differences with physical characteristics) OR: H.2L.5 (explain how multiple lines of scientific evidence supports biological evolution) ID: 9-10.B.1.1.1 (explain the scientific meaning of systematic order and organization) 9-10.B.3.1.1 (use the theory of evolution to explain how species change over time)	
Focus Questions:	In order to protect, restore, and manage an endangered population, what factors influence population size? What questions drive scientists to study recovering populations?	
Learning Objectives:	At the end of this lesson students will be able to: <ul style="list-style-type: none"> • Organize natural history traits into categories • Differentiate how biological and human impacts might influence population size • Interpret graphs of two similar populations to find trends and patterns 	
Engage and Encounter	Pre-Test Population demonstration, influence of births and deaths on population size	
Explore and Investigate	Distribute trading cards and have students organize them into natural history categories	
Reflect and Explain	Have students determine what potential biological or human impacts might influence population size http://www.whaleresearch.com/orca_ID_pods.html and analyze two graphs of similar population. Have students brainstorm why one is healthier than the other.	
Apply and Extend	To learn more about current research projects visit NOAA's website: http://www.nwfsc.noaa.gov/publications/documents/srkw_newsletter.pdf Sustainability is in your hands poster/website: test species I.D. within marine ecosystem. http://www.nmfs.noaa.gov/speciesid/Sustainability.html	
Background for teacher	Four levels of social structure have been identified among resident killer whales. The basic and most important social unit is the matriline, which is a highly stable hierarchical group of individuals linked by maternal descent (Baird 2000, Ford et al. 2000, Ford 2002, Ford and Ellis 2002). A matriline is usually composed of a female, her sons and daughters, and offspring of her daughters, and contains one to 17 (mean= 5.5) individuals spanning one to five (mean=3) generations. Members maintain extremely strong bonds and individuals seldom separate from the group for more than a few hours. Groups of related matriline are known as pods (like J, K, and L pods). Matriline within pods share a common maternal ancestor from the recent past, making them more closely related to one another than to those of other pods (Baird 2000, Ford et al. 2000). Currently there are about 85 whales in all three pods and are listed as endangered species. Clans are the next level of social structure and are composed of pods with similar vocal dialects and a common, but older maternal heritage (Ford 1991, Ford et al. 2000, Yurk et al. 2002). Pods (and clans) that regularly associate with one another are known as communities, which represent the highest level of social organization in resident killer whale societies (Ford et al. 2000, Ford 2002). In regards to factors that influence population size, have students think of birth and death rates, predation, habitat destruction, competition of resources, etc. Remind students that the carry capacity is not static and population sizes change due to many complex factors. Have them explore different scenarios and the outcomes and then have them generate questions and testable experiments to better understand what how some of these factors might be addressed to help protect the species or population. Longevity and mortality will be addressed in the next lesson and students will use the trading cards again to better understand the population.	
Contact NOAA	For a guest speaker in lesson 5 email: nwr.education@noaa.gov	

Lesson 1 Procedures

Natural History and Population Parameters: Trading Cards

I. Anticipatory Set: (10 minutes)

- A. **Pre-Test:** Have students answer the 5 questions; turn in when done. Then use the same paper to hand back as a POST TEST in lesson 5 or when done.
 1. Describe the Southern Resident killer whale population and its status.
 2. What dietary challenges do these whales face?
 3. What factors of environmental contaminations most concern this population?
 4. How does anthropogenic noise effect their survival?
 5. Who studies and manages the Southern Resident population?
- B. Have students pass up the quizzes and save for later; if they have lab books/notebooks you could have them save a page for the post test rather than collecting.

II. Direct Instruction: (35 minutes)

- A. **Brainstorm:** In order to protect, restore, and manage an endangered population, what factors influence population size and which ones are priorities? Births and deaths.
- B. **Demonstration:** Pour water into a plastic bottle that has a small hole near the bottom; highlighting that the input of water indicates birth rates and the output or loss from the bottle indicates death rate. Have half the class turn to their neighbor and ask what may cause the birth rate to increase or decrease and the other half focus on how death rate could increase or decrease.
- C. **Trading Card Activity:** (Place 10 category signs around the room prior to class).
 1. Divide the approximately 80 cards evenly amongst students or table groups.
 2. Tell the students that there is a natural history fact about killer whales on each card. Challenge the students to organize them according the categories.
 3. Once all of the cards are distributed in the categories, have the students briefly summarize some of the characteristics of that group.
 4. Next, have the students determine which categories help describe population dynamics, size, or factors that could influence a population increase or decline. The three main threats to these animals are (prey availability, contaminants, and vessel effects and noise).
 - a. Distribution, habitat and range (The habitat is unhealthy throughout range)
 - b. Diet and foraging (salmon abundance is low and salmon may contain toxins)
 - c. Vocalizations, sound, and other senses (vessel effects and noise affect communication which is vital to navigation, foraging, and socializing)
 - d. Social organization (Small population size and tight social society, if a large scale catastrophe happened and all three pods was present, it could wipe out the whole population at once.)
 5. Hand out worksheet and have them be ready to share the next day.

III. Assessment:

- A. Pre-Test to be compared with Post Test at the end.
- B. Participation in trading card activity
- C. **Homework:** Have students generate scenarios that support an increasing, decreasing, or stable population and then testable questions to address these factors.

IV. Apply and extend:

- A. If students want to learn more about research on whales; share with them some reading sources such as the Northwest Fisheries Science Center Research Update.
http://www.nwfsc.noaa.gov/publications/documents/srkw_newsletter.pdf
- B. Have students test their knowledge of species I.D. using this website
<http://www.nmfs.noaa.gov/speciesid/Sustainability.html> to see how killer whales are only one element of the marine food web.

Name:

Period:

NOAA's Killer Whale Recovery Pre and Post Test

1. Describe the Southern Resident killer whale population and its status.
2. What dietary challenges do these whales face?
3. What factors of environmental contaminations most concern this population?
4. How does anthropogenic noise effect their survival?
5. Who studies and manages the Southern Resident population?

****POST TEST: Have students use a different color of pen/pencil and make any changes to the Pre-Test.**



Factors that influence population size

How does the size of a population influence genetic diversity?

What factors might cause an increase in population?

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-
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What questions would you want to ask to better understand the above factors?

What factors might cause a decrease in population?

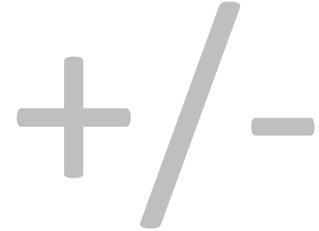
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What questions would you want to ask to better understand the above factors?

What qualifies as a stable population?

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What questions would you want to ask to better understand the above factors?

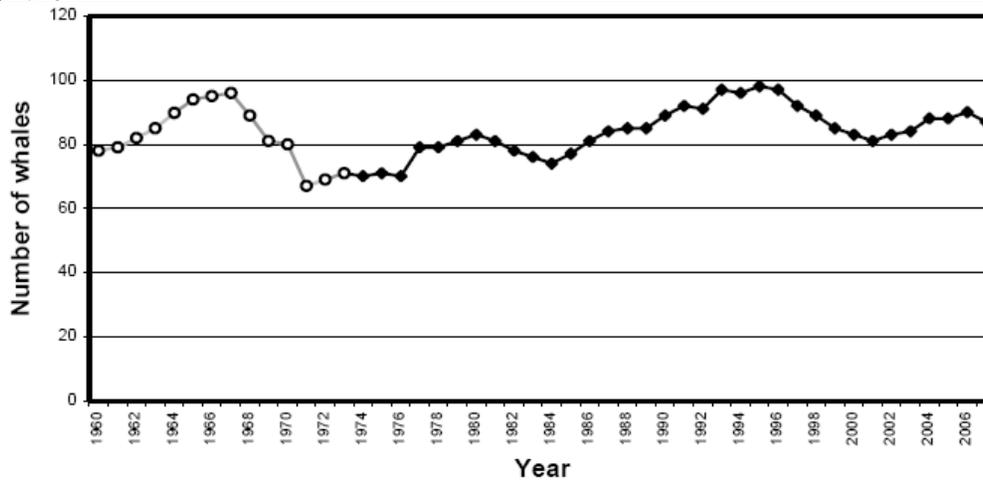
Describe the role of carrying capacity in managing populations?

What is a population bottleneck? What implications does this have for recovery?

Comparing Populations using Graphs



Graph 1: Population size and trend of Southern Resident killer whales, 1960-2007. Data from 1960-1973 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990a). Data from 1974-2007 (diamonds, black line) were obtained through photo-identification surveys of the 3 pods (J, K, and L) in this community and were provided by the Center for Whale Research (unpubl. data). Data for these years represent the number of whales present at the end of each calendar year except for 2007, when data extend only through October.



What is the maximum value (highest population size):

What is the minimum value?

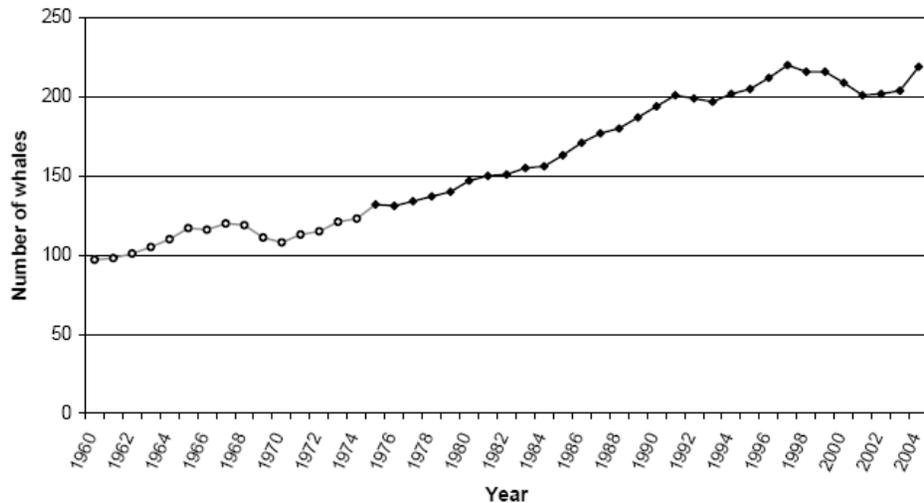
Range:

Average (eye ball this):

Trends over the years:

The capture periods in Puget Sound were in the late 60's and early 70's. Why do you suppose it took about 20 years for the population to increase to its estimated levels?

Graph 2: Population size and trend of Northern Resident killer whales, 1975-2004. Data from 1960-1974 (open circles, gray line) are number projections from the matrix model of Olesiuk et al. (1990a). Data from 1975-2004 (diamonds, black line) were obtained through photo-identification surveys of the 16 pods in this community and were provided by J. K. B. Ford (unpubl. data) and Olesiuk et al. (2005).



What is the maximum value (highest population size):

What is the minimum value?

Range:

Average (eye ball this):

Trends over the years:

How would you describe the health of this population? Why?

Comparison to
other whales or
animals

Vocalizations,
sound, and other
senses

Body plan and ID.
features

Swimming, dive
behaviors, surface
active behaviors

Diet and foraging

Distribution, habitat, and range

Social organization

Identifying
individuals, birth,
and age expectancy

Status and human
interactions/impacts

Conservation